FUTURE FISHERIES IMPROVEMENT PROGRAM
GRANT APPLICATION
(please fill in the highlighted areas)

I. APPLICANT INFORMATION

A. Applicant Name: Montana Fish, Wildlife & Parks

B. Mailing Address: 4600 Giant Springs Rd.

C. City: Great Falls State: MT Zip: 59405

Telephone: 406-791-7775

D. Contact Person: David Moser, Montana Fish, Wildlife & Parks

Address if different from Applicant:

City: State: Zip:

Telephone:

E. Landowner and/or Lessee Name (if other than Applicant): United States Forest Service

Mailing Address: 4234 US Highway 89 North

City: Neihart State: MT Zip: 59465

Telephone: 406-236-5100

II. PROJECT INFORMATION*

A. Project Name: Barker-Hughesville Reclamation Area Fish Barrier

River, stream, or lake: Dry Fork Belt Creek

Location: Township 15N Range 10E Section 2

County: Cascade

B. Purpose of Project:

Westslope cutthroat trout restoration

C. Brief Project Description:

The Dry Fork of Belt Creek has a long history of mining. The Block P and other mines produced lead silver ores from prior to the 1800's until the 1940's resulting in accumulated mine waste placement adjacent to the Dry Fork of Belt Creek and Galena Creek. The Environmental Protection Agency (EPA) listed the Dry Fork Belt Creek area as a federal Superfund site in 2000 due to the threat of metals contamination to humans and the environment. The mining effects rendered segments of the Dry Fork and its tributaries uninhabitable for fish and most other aquatic species. EPA and the Forest Service have negotiated and reached agreement with responsible parties (PRPs) to conduct cleanups in this drainage which has resulted in two major removal efforts, one still ongoing. The scope of the PRP negotiated cleanups have been limited to direct waste removal and placement in a repository. EPA also recovered limited cleanup costs from the Asarco, LLC bankruptcy and some of these funds are being used as cash match in this project. Recently, efforts have begun to reclaim mine waste in the headwaters of Dry Fork Creek. Previously fishless areas of upper Dry Fork, specifically Galena Creek may at some time be able to support fish populations. The improvement of water quality conditions for fish will have the unwanted effect of putting existing remnant populations of westslope cutthroat trout (WCT) at increased risk for invasion by nonnative fish species. Nonnatives residing downstream could potentially invade the barren reaches of the Dry Fork of Belt Creek as water quality conditions improve following mine reclamation. Mine reclamation at the Block P mine complex was initiated in 2011 and will continue into 2012-13. The Block P and its adjacent mines are primary contributors to water quality degradation in the Dry Fork of Belt Creek (Techlaw, Inc., February, 2011; Barr Engineering, Inc., 2011).

In the absence of barriers to upstream movement of non-native fishes, t WCT typically either become hybridized with rainbow trout or are displaced by brook trout. Non-hybridized WCT currently occupy less than 4% of historically occupied habitat in northcentral Montana (Moser, 2010). In addition, hybridized populations of WCT (< 10% hybridization) occupy approximately 6% of historically occupied habitat of this area (Moser, 2010). Existing non-hybridized populations are relegated to small sections of headwater streams and are protected from non-native fishes by waterfalls or man-made barriers.

To mitigate for the potential decrease in genetic purity and total numbers of WCT, we propose construction of a fish barrier and removal of non-native fishes upstream of the fish barrier. The proposed barrier location – approximately two miles upstream of the mouth of Dry Fork Creek - was based upon site characteristics; primarily channel incisement, access for construction equipment, and stream gradient (Figure 1). Upstream areas with significantly wider floodplains were considered for construction of a fish barrier and deemed cost prohibitive. In addition, the proposed barrier location is typically dry during late summer. Locating the fish barrier in an ephemeral portion of the channel should reduce costs associated with barrier construction (diverting water around the channel). We have included water management in budgets associated with this project in the event of unforeseen rainfall events.

The Dry Fork of Belt Creek currently supports five tributary populations of WCT greater than 99% genetic purity. The mainstem Dry Fork supports primarily non-native brook trout. Other species present in lower numbers in the Dry Fork include: rainbow trout, hybridized WCT, and long nosed dace. Construction of a fish barrier near the mouth of the Dry Fork; combined with removal of existing non-native fishes in the mainstem and a few tributaries, will address the difficult goal of maintaining a large metapopulations of WCT that exhibit multiple life histories.

D. Length of stream or size of lake that will be treated: 26

E. Project Budget:

Grant Request (Dollars): $ $10,000

Contribution by Applicant (Dollars): $ N/A In-kind $
(salaries of government employees are not considered as matching contributions)

Contribution from other Sources (Dollars): $ $144,200 In-kind $
(attach verification - See page 2 budget template)

Total Project Cost: $ $154,200

F. Attach itemized (line item) budget – see template

G. Attach specific project plans, detailed sketches, plan views, photographs, maps, evidence of landowner consent, evidence of public support, and/or other information necessary to evaluate the merits of the project. If project involves water leasing or water salvage complete supplemental questionnaire (fwp.mt.gov/habitat/futurefisheries/supplement2.doc).

H. Attach land management and maintenance plans that will ensure protection of the reclaimed area.

III. PROJECT BENEFITS*

A. What species of fish will benefit from this project?:

Westslope cutthroat trout *(Oncorhynchus clarkii lewisi)*

B. How will the project protect or enhance wild fish habitat?:

- Prevent upstream movement of non-native fishes through construction of a fish barrier approximately 2 miles upstream of the confluence of Belt Creek and Dry Fork Belt Creek (completed by 2013).
- Eliminate competition and hybridization from non-native fishes through removal of non-native fishes from approximately 20 miles of Dry Fork Creek and Oti Park Creek (completed by 2015).
- Expand WCT downstream from headwater areas through collection, fertilization, and transfer of eggs to lower elevation reaches. This will increase the potential miles of stream available for WCT from the current 6 miles to 26 miles. (completed by 2018).

C. Will the project improve fish populations and/or fishing? To what extent?:

The impetus for this project was mine remediation activities in the headwaters of Dry Fork Belt Creek. Cleanup of mine waste should, over time, improve fish populations and consequently fishing opportunities in the Dry Fork.

D. Will the project increase public fishing opportunity for wild fish and, if so, how?:

The Cutthroat trout is the State fish of Montana. The WCT is the only trout native to the Missouri River drainage. WCT are part of the history and legacy of Montana. Westslope cutthroat trout were first described by Lewis and Clark in 1805 near Great Falls, Montana. Currently, state fishing regulations are catch and release only for WCT in streams and rivers. If this project were implemented, WCT populations in the Dry Fork would likely reach densities high enough to allow limited harvest by the public. This project would directly benefit the public by expanding the native populations of WCT downstream to more highly fished areas; while still allowing a limited harvest for human consumption.

E. If the project requires maintenance, what is your time commitment to this project?:

Montana Fish, Wildlife & Parks is committed to protecting native westslope cutthroat trout over the long term. Previous maintenance issues with constructed fish barriers have been addressed rapidly. Our commitment to maintenance of the fish barrier and the associated metapopulation of westslope cutthroat trout is a priority.

F. What was the cause of habitat degradation in the area of this project and how will the project correct the cause?:

Habitat degradation in the project area was caused by long term mining activities in the basin. Current mine cleanup activities (see project description section) should address habitat limitations. This project will address impacts to native populations of westslope cutthroat trout from previous stocking of non-native fishes and continued upstream movement of non-native fishes from Belt Creek.

G. What public benefits will be realized from this project?:

This project will ensure that westslope cutthroat trout, Montana's state fish and the only trout native to the Dry Fork of Belt Creek drainage, is preserved over the short and long term by providing for expansion of its habitat. Current mine remediation activities, if successful, will create conditions amenable to the survival and reproduction of trout species. Much of the current Dry Fork Belt Creek drainage - primarily mainstem and lower reaches of tributaries – is currently occupied by non-native brook trout and rainbow trout. These large sources will be the primary source for recolonization of fishless reaches. The lower reaches of Gold Run Creek support a genetically pure population of WCT. In the event Galena Creek is restored by reclamation, Lower Gold Run Creek WCT would be directly threatened by invasion of brook trout and rainbow trout. Upper Dry Fork Belt Creek, including Oti Park Creek are currently slightly hybridized and in competition with brook trout. If Galena Creek and mainstem Dry Fork Belt Creek habitat quality improves significantly the current rate of invasion and subsequent hybridization and competition may increase in upper portion of the Dry Fork of Belt Creek.

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Projects which restore WCT to historical habitats are crucial to preventing future listing of WCT under the Endangered Species Act. If WCT were to ever be listed as threatened or endangered there is a potential for increased federal regulatory restrictions on land use.

With the increase in available habitat for WCT in a popular public recreation area, this project will provide an indirect benefit to recreationists who enjoy fishing for a native species.

(References available upon request)

H. Will the project interfere with water or property rights of adjacent landowners? (explain):

No

I. Will the project result in the development of commercial recreational use on the site?: (explain):

No

J. Is this project associated with the reclamation of past mining activity?:

Yes

Each approved project sponsor must enter into a written agreement with the Department specifying terms and duration of the project.

IV. AUTHORIZING STATEMENT

I (we) hereby declare that the information and all statements to this application are true, complete, and accurate to the best of my (our) knowledge and that the project or activity complies with rules of the Future Fisheries Improvement Program.

Applicant Signature: _____ Date: _____

Sponsor (if applicable): _____

***Highlighted boxes will automatically expand.**

Mail To: **Montana Fish, Wildlife & Parks**
Habitat Protection Bureau
PO Box 200701
Helena, MT 59620-0701

Incomplete or late applications will be returned to applicant.

Applications may be rejected if this form is modified.

*****Applications may be submitted at anytime, but must be received by the Future Fisheries Program office in Helena before December 1 and June 1 of each year to be considered for the subsequent funding period.*****

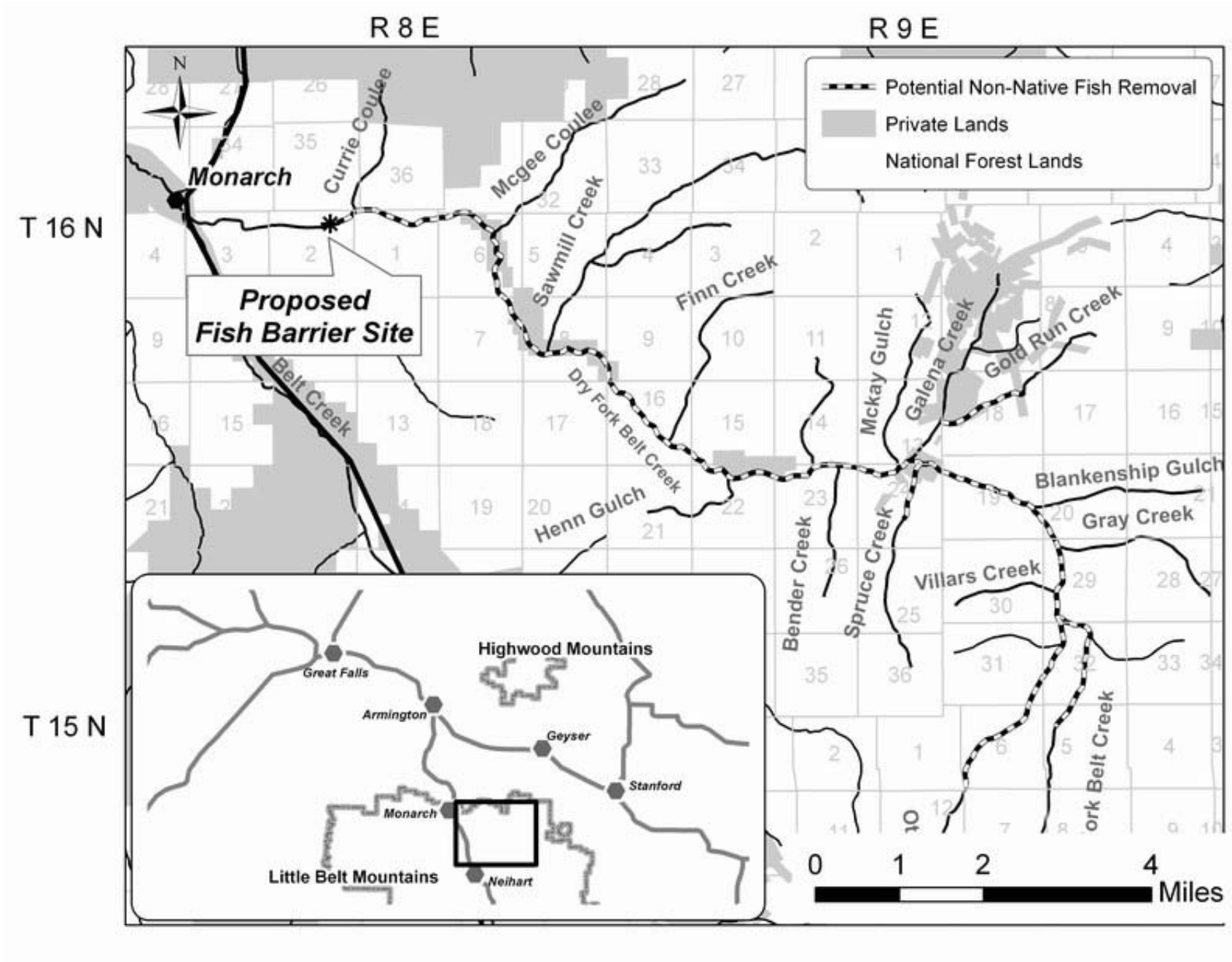

Figure 1 Location of barrier site and potential restoration area, Dry Fork Belt Creek.

Dry Fork Belt Creek Fish Barrier Conceptual Design

Background

Restoration and protection of native westslope cutthroat trout populations require the elimination of competing and hybridizing non-native fish species. The only method currently available to prevent upstream movement of on-native species is through construction of fish barriers. Several key site characteristics (gradient, incision, and access) are necessary to cost effectively construct a barrier under widely ranging flow regimes. Upstream reaches of Dry Fork Belt Creek are characterized by wide, low gradient floodplains. The only viable barrier sites were located in the lowermost reaches of stream near the confluence with Belt Creek. A potential site was identified approximately 2 miles upstream of the confluence of Belt Creek and Dry Fork creeks (Figure 1 and 2).

In-stream structures can function as a barrier to upstream movement of fish in several ways:

1. Height Barrier: The structure provides a vertical distance between the downstream water surface and structure crest greater than the vertical distance a fish can leap;
2. Horizontal Distance Barrier: Flow though the structure forms a jet or projectile stream which intersects the downstream water surface at a horizontal distance downstream of the structure. Observations of fish at barriers indicate fish initiate their leap at the downstream edge of the apron where the flow transitions from supercritical to subcricital. Once the fish leaves the water surface, they can no longer accelerate and their trajectory follows a projectile path. If the horizontal distance from the leaping point to the flow jet is greater than the horizontal distance of the leap trajectory, then the structure forms a horizontal distance barrier, even if the fish vertical leaping distance is higher than the structure; and
3. Velocity Barrier: A velocity barrier is formed when the structure flow velocity is greater than the burst speed velocity of the fish or the structure flow velocity is less than the fish burst velocity but is sustained over a greater distance than the fish can maintain its burst velocity. Typically the downstream apron of a barrier structure is designed to be a velocity barrier.

A height and velocity barrier was conceptualized as the proposed structure to be constructed of cast in-place concrete. The minimum fish barrier design criteria are to deny fish passage up to a 50-year flow event and be structurally stable for the 100-year flow event. Design iterations resulted in a retaining wall type structure with an elevated downstream apron. The crest of the barrier is set approximately 3.5 ft above the downstream apron backwater pool depth elevation with a crest length of 35 ft. (Figure 3). The proposed barrier geometry was selected to be consistent with a contracted rectangular weir. The proposed barrier shall extend the width of the channel and be anchored to existing bedrock. A concrete footer will be constructed as a support element where bedrock is not available.

To increase velocities and decrease flow depth in the reach downstream of the barrier an elevated concrete apron is proposed to be installed over the channel bed.

Analysis Methodology

Design hydrology was developed using USGS regression-based methods for ungaged watersheds.

Hydrology

No gaging stations with sufficient periods of records exist for the Dry Fork Creek watershed. Therefore flood discharges were estimated using the Montana USGS *Methods for Estimating Flood Frequency in Montana Based on Data Through the Water Year 1998 WRIR 03-4308* (http://mt.water.usgs.gov). Two regional flood-frequency estimating methods were used to develop a set of design discharges. The first calculation method uses a regression analyses based equation to calculate flows with recurrence intervals as a function of basin characteristics for ungaged watersheds. The second method uses a regression analysis based on the average bankfull width of the channel. The two methods were combined to yield a weighted regression estimate.

The USGS regression method organizes the state into 8 regions within which flood characteristics are considered to be homogeneous. For each of these regions regression equations are developed. The barrier site is located at Latitude/Longitude 47.0937°N, 110.8050°W with the site at an approximate elevation of 4700 ft. This places the site in the Upper Yellowstone – Central Mountain Region (Figure 4).

The Dry Fork Creek drainage was analyzed for the Upper Yellowstone region of the state with an estimated drainage area of 60 square miles and approximately 80% of the basin above 6,000 feet in elevation. Figure 4 shows the watershed area contributing flow to the project site. Calculations were conducted using the USGS on-line flood frequency estimating calculator. Channel bankfull widths were estimated using the survey data with a resultant average bankfull width of 31 feet.

Upper Yellowstone

Weighted estimate based on Basin and Climatic Characteristics and Bankfull width

Flow Recurrence (y)	Design Discharge (cfs)	Lower 90% CI	Upper 90% CI
2	286	81	1000
5	512	211	1240
10	701	302	1620
25	953	418	2170
50	1140	497	2620
100	1330	565	3110

The downstream invert of the apron was set at an elevation to allow 1.0 feet of vertical change between the downstream water surface and the apron invert during a 50-year event, as the 50-year event had the highest downstream water surface elevation between the 2 and 50-year flows. This eliminates the potential for a submerged apron. The apron slope is designed at a 16H:1V slope to provide supercritical flow. The crest of the barrier is designed to be a minimum 3.5 feet above the resultant backwater pool depth estimate. A berm on the right side of the channel was determined to be necessary to contain the upstream water during flows in excess of a 50-year event. A sloped concrete apron will eliminate a plunge pool below the barrier structure.

Design of the apron surface is based on Bureau of Reclamation (BOR) in document *Fish Protection at Water Diversions* (BOR, 2006). A minimum apron length of 16 feet with a slope of 16 feet horizontal to 1 foot vertical (16H:1V) is proposed. Trout Leaping Capability

Fish leaping curves were developed using projectile equations based on the fish burst speed and the angle the fish leaves the water. Use of these equations for estimating fish leaping curves are documented in *Analysis of Barriers to Upstream Fish Migration*, Department of Energy, Bonneville Power Administration, August 1985; and the

documentation for the USFS software *Fishxing, v.2.10*.

The reference burst speed used in the analysis is 14 feet per second (fps) and is based on research conducted by Milo Bell and published in the Army Corp of Engineers document: *Fisheries Handbook of Engineering Requirements and Biological Criteria,* Fish Passage Development and Evaluation Program, Corps of Engineers, North Pacific Division, Portland OR, 1990. 14 fps is the darting speed value published for cutthroat trout.

A laboratory evaluation of brook trout jumping performance presented in *Transactions of the American Fisheries Society 135:361-370, 2006* determined that 8.6 – 34.0 cm brook trout highest jumping capability was 73.5 cm (2.4 feet) with a plunge pool at 40 cm (1.3 feet) deep (Kondratieff and Myrick, 2006). Also, shallow plunge pools severely reduced jumping ability with a maximum jump of 33.5 cm (1.1 feet) with a 10 cm (0.33 feet) pool.

In natural channels where plunge pools exist, a standing wave will form just downstream of the jet intersection with the downstream water surface. The fish will use this standing wave to help them leap. A plunge pool with a depth at least 1.25 times the drop height (difference in upstream and downstream water surface elevations) must exist for a standing wave to form close to the barrier (*Stream Enhancement Guide,* British Columbia Ministry of Environment, 1980). When a pool does not exist or is less than 1.25 times the required leap height, the standing wave will not form or will form too far downstream to be of use for a leaping fish to pass the barrier. The proposed concrete apron will eliminate the formation of a standing wave downstream of the barrier. In addition, the apron will create shallow and fast flows that will decrease the jumping performance of fish attempting to pass the barrier from the 2-year to 50-year events.

Erosion Protection

The proposed design includes concrete wing walls along either side of the downstream apron to eliminate refugia and potential low velocity areas. These wing walls will also provide erosion protection for the adjacent banks.

Results

2-Year Flow

Flow velocities on the barrier apron would conceivably be low enough for a fish to swim given adequate depth. However, under the two year flow scenario water depth on the apron surface would be far too shallow for a fish to swim to the base of the barrier wall (approximately 0.1 ft.). In addition, a fish would be unable to leap to the barrier crest (approximately 4 feet) due to the low water depth on the apron and estimated jumping capabilities of trout.

50-Year Flow

The analysis indicates a vertical distance of approximately 3.2 feet between the downstream water surface at the foot of the barrier to the barrier weir crest (This includes loss of 1 ft. of drop with a 16:1 sloping of the apron). This provides 0.4 feet of freeboard above the maximum estimated fish leap height. Flow velocities on the apron based upon previous barrier designs are estimated to be 16 – 18 fps. For a maximum burst velocity of 14 fps, migrating fish would be unable to sustain upstream swimming on the apron during the 50-year flow.

100-Year Flow

Under the 100-year flow the fish barrier would still likely function. Additional flow volume would increase the head approximately 0.5 ft. Given the amount of designed drop and flow velocities on the apron the barrier would also effectively block trout primarily through velocity with some drop.

Design Summary

A cast in place concrete weir fish barrier will meet the minimum criteria of blocking fish up to the 50 year event and could be designed to prevent upstream movement of fish at flows greater than the 50 year. Similar structures which incorporate a notch, wing walls and a sloped apron have been constructed in other areas of northcentral Montana (Figure 5).

Budget

Design and Engineering

Tasks	Description	Cost
1	Engineering Analysis, design, and engineering	$ 18,200

Budget Summary

Item	Description	Unit	Quan.	Unit Cost	Total	Description
1	Mobilization/Demobilization	LS	1	$7,000	$7,000	Includes all prep work for transport and movement of personnel, equipment, supplies and incidentals to/from the project site.
2	Clearing, Grubbing and Demolition	LS	1	$4,000	$4,000	Includes clearing and grubbing work areas and removal of existing woody debris
3	Water Management	LS	1	$25,000	$25,000	Includes stream flow diversion, work area dewatering, storm water management and sediment control
4	Structure Construction	LS	1	$83,000	$83,000	Includes general excavation, backfill, all materials, placing any special subgrade materials, formwork, rebar, placing concrete, stripping forms, finishing, and berm construction
5	Reclamation and Revegetation	LS	1	$3,000	$3,000	Includes grading and vegetation of disturbed areas
	Construction Subtotal				$122,000	
	Construction Contingency				$12,200	20% construction cost contingency
	Construction Total				$134,200	Total construction cost estimate with 20% contingency.
	Construction Oversight	**T&M**			$14,000	Includes construction surveying, on-site observation, submittal reviews and design field adjustments. (15-10hr days)
	Grand Total				$148,200	

References

Kondratieff, M. C., and C. A. Myrick, 2005. Two adjustable waterfalls for evaluating fish jumping performance. Transactions of the American Fisheries Society, 134(2), 503-508.

BOR. Water Resources Technical Publication. 2006. Fish Protection at Water Diversions: A Guide for Planning and Designing Fish Exclusion Facilities. U.S. Department of the Interior Bureau of Reclamation,Denver,CO

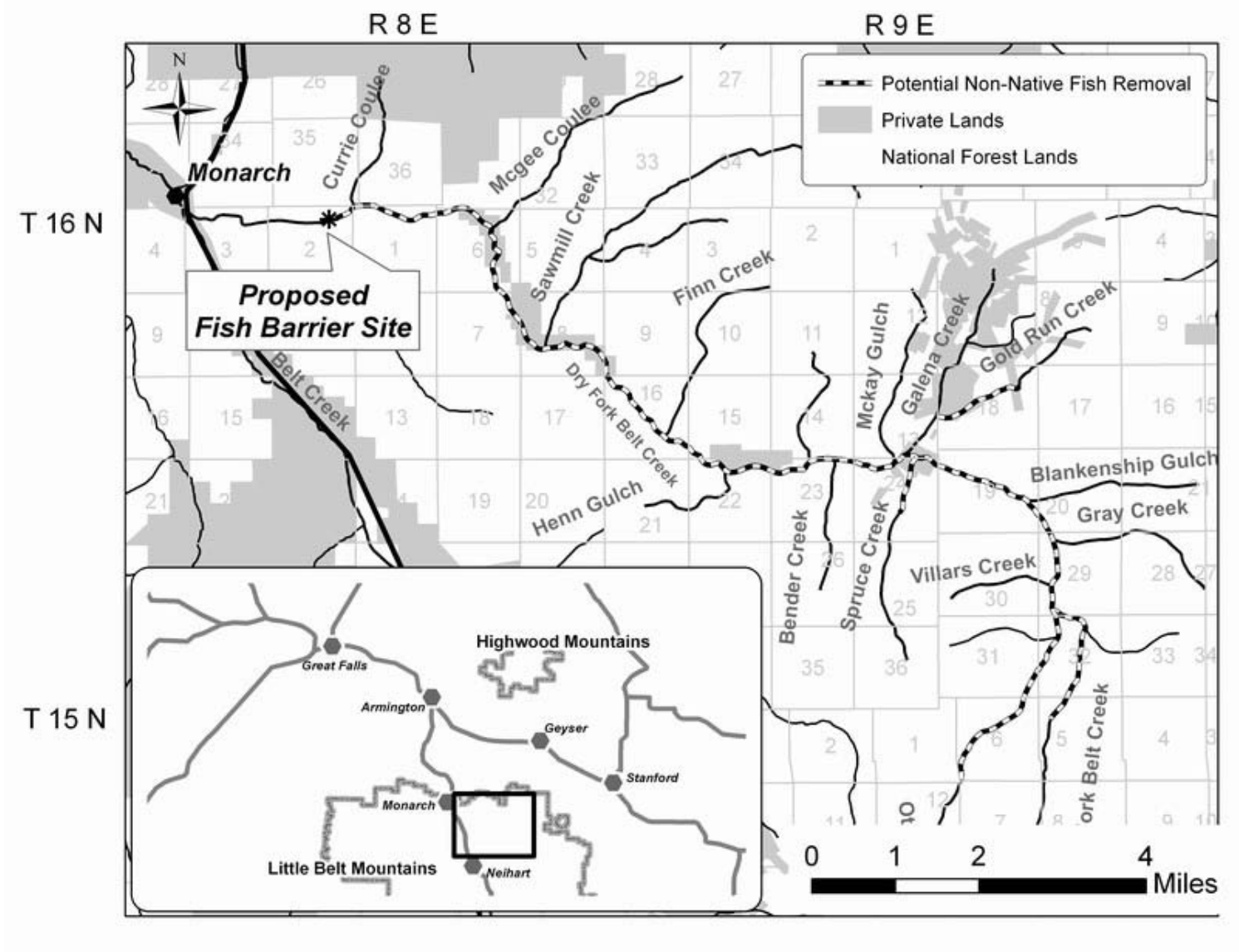

Figure 1. Site location of proposed fish barrier.

Figure 2. Barrier site, looking downstream.

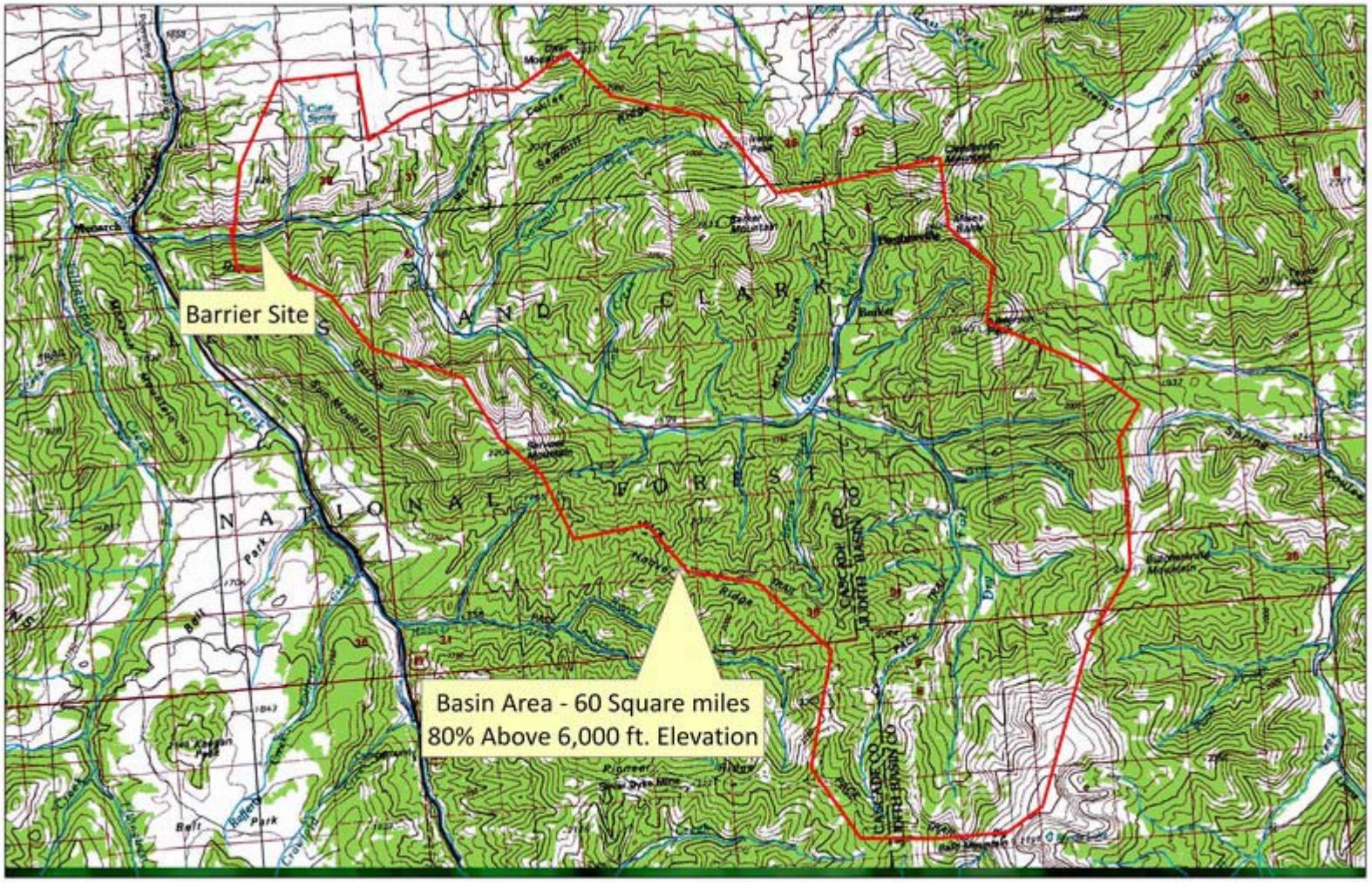

Figure 3. Basin area used to for regional flow recurrence.

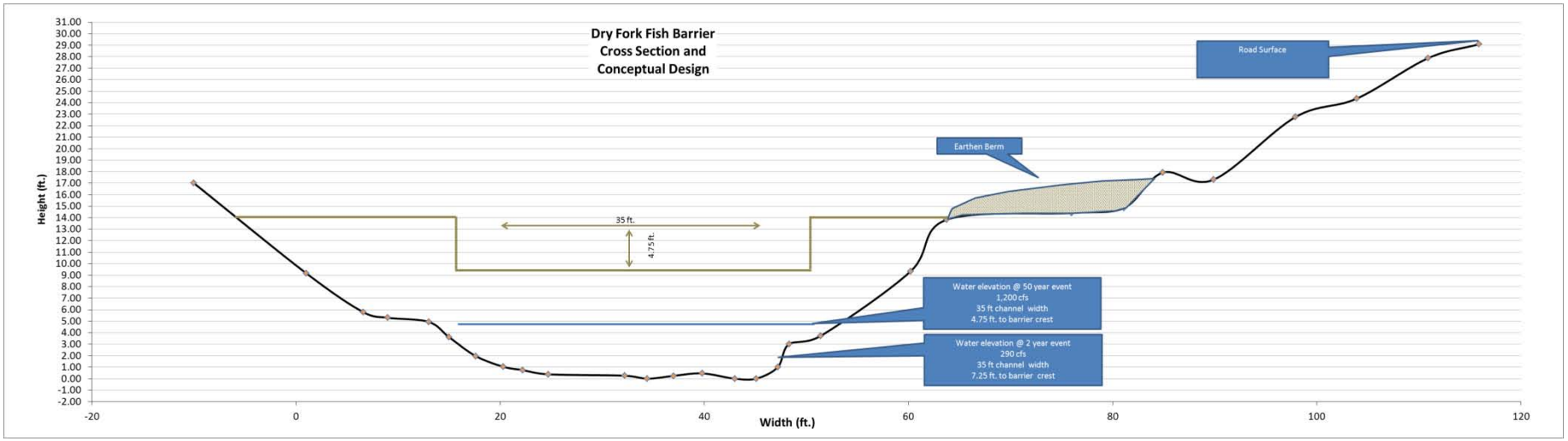

Figure 4. Stream profile and basic configuration of fish barrier.

Figure 5. Smith Creek fish barrier, Highwood Mountains, displaying typical design characteristics.